



*ITW*

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of:  
**FLATMAN**

Serial No.: 10/724,094  
Filed: 12/1/03

Group: 3644  
Examiner: BAREFOOT, Galen L.

For: ENVIRONMENTAL CONTROL SYSTEM

**PRIORITY CLAIM SUBMISSION AND CERTIFIED COPY**

Date: January 31, 2005

Hon. Commissioner of Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

It is respectfully requested that under the provisions of 35 USC 119/365, this application be given the benefit of the foreign filing date of the following, a certified copy of which is attached hereto:

Application No.  
0229157.3

Country of Origin  
Great Britain

Filed  
12/14/02

Respectfully submitted,

*[Signature]*  
W. Warren Taltavull  
Reg. No. 25647

MANELLI DENISON & SELTER PLLC  
2000 M Street N.W. Suite 700  
Washington D.C. 20036  
202 261 1047



INVESTOR IN PEOPLE

The Patent Office  
Concept House  
Cardiff Road  
Newport  
South Wales  
NP10 8QQ

## CERTIFIED COPY OF PRIORITY DOCUMENT

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

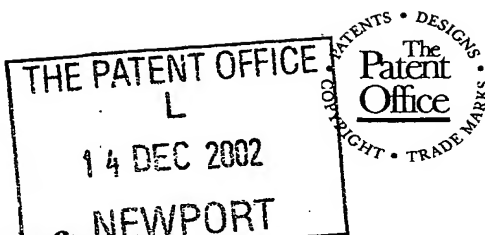
Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed

Dated 22 October 2003



Patent 1977  
(Rule 10)



160EC02 E771024-1 000370  
P01/7700 0.00-0229157.3

# Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road  
Newport  
South Wales  
NP10 8QQ

1. Your reference

DY3056

2. Patent application number

(The Patent Office will fill in this part)

0229157.3

3. Full name, address and postcode of the or of each applicant (underline all surnames)

ROLLS-ROYCE PLC  
65 BUCKINGHAM GATE  
LONDON  
SW1E 6AT

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

ENGLAND

3970002

4. Title of the invention

ENVIRONMENTAL CONTROL SYSTEM

5. Name of your agent (if you have one)

M A GUNN

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

ROLLS-ROYCE plc  
PATENTS DEPARTMENT  
PO BOX 31  
DERBY  
DE24 8BJ

Patents ADP number (if you know it)

3962002

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number  
(if you know it)

Date of filing  
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

- a) any applicant named in part 3 is not an inventor, or
  - b) there is an inventor who is not named as an applicant, or
  - c) any named applicant is a corporate body.
- See note (d))

YES

9. Enter the number of sheets for any of the following items you are filing with this form.  
Do not count copies of the same document

Continuation sheets of this form

Description

5

Claim(s)

2

Abstract

1

Drawing(s)

2-1+1

(2 figures on 1 page)

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

2

Request for preliminary examination and search (Patents Form 9/77)

1

Request for substantive examination (Patents Form 10/77)

1

Any other documents (please specify)

DEPOSIT ACCOUNT FEE SHEET

11.

I/We request the grant of a patent on the basis of this application.

Signature

M A GUNN

Date

13.12.2002

12. Name and daytime telephone number of person to contact in the United Kingdom

M A GUNN

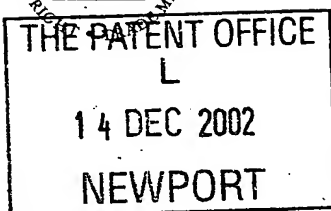
01332 249457

### Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

### Notes

- If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.
- Write your answers in capital letters using black ink or you may type them.
- If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.
- If you have answered 'Yes' Patents Form 7/77 will need to be filed.
- Once you have filled in the form you must remember to sign and date it.
- For details of the fee and ways to pay please contact the Patent Office.



7/77

# Statement of inventorship and of right to grant of a patent

The Patent Office

Cardiff Road  
Newport  
South Wales  
NP10 8QQ

1. Your reference

DY3056

2. Patent application number  
(if you know it)

0229157.3

3. Full name of the or of each applicant

ROLLS-ROYCE PLC

4. Title of the invention

ENVIRONMENTAL CONTROL SYSTEM

5. State how the applicant(s) derived the right from the inventor(s) to be granted a patent

BY VIRTUE OF AN AGREEMENT DATED 28 NOVEMBER 2002

6. How many, if any, additional Patents Forms 7/77 are attached to this form?  
(see note (c))

1

7.

I/We believe that the person(s) named over the page (and on any extra copies of this form) is/are the inventor(s) of the invention which the above patent application relates to.

Signature

Date

8. Name and daytime telephone number of person to contact in the United Kingdom

M A GUNN

13.12.2002

M A GUNN

01332 249457

## Notes

- If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.
- Write your answers in capital letters using black ink or you may type them.
- If there are more than three inventors, please write the names and addresses of the other inventors on the back of another Patents Form 7/77 and attach it to this form.
- When an application does not declare any priority, or declares priority from an earlier UK application, you must provide enough copies of this form so that the Patent Office can send one to each inventor who is not an applicant.
- Once you have filled in the form you must remember to sign and date it.

Enter the full names, addresses and postcodes of the inventors in the boxes and underline the surnames

RICHARD JAMES FLATMAN  
32 CORNHILL  
ALLESTREE  
DERBY  
DE22 2FS

1062447001

Patents ADP number (if you know it):

Patents ADP number (if you know it):

Reminder

Have you signed the form?

Patents ADP number (if you know it):

DUPLICATE

ROLLS-ROYCE plc

CASE NO: DY3056

RR TITLE: [REDACTED]

APPLICATION NO:

DATED: 14 DECEMBER 2002

FIRST APPLICATION

DRAFTED BY: Hry FOR Gnn

PATENTS ACT 1977

SPECIFICATION

ENVIRONMENTAL CONTROL SYSTEM

## ENVIRONMENTAL CONTROL SYSTEM

The present invention relates to a system with which  
5 to control the atmosphere breathed by people in the  
confines of the cabin of a vehicle. The invention has  
particular efficacy, but not necessarily restrictively,  
when used in a passenger aircraft.

It is known, for example in published patent  
10 specification US6,216,981, to compress ambient air so as to  
heat it, then expand the heated air through a turbine so as  
to maintain some of the achieved pressure, and lower the  
achieved temperature. The still warm air is then passed  
through a mixing valve and water separating device prior to  
15 being passed to the passenger cabin of an associated  
aircraft. The breathed air is then dumped overboard.

In the publication, the compressors and turbines are  
driven by individual motors, which receive electricity from  
individual generators, which in turn are powered via  
20 connections to the main propulsion engines of the aircraft.

The known arrangement as described hereinbefore has a  
drawback, in that when the aircraft is at cruise altitude,  
that is when maximum pressurisation of the cabin is needed.  
Consequently, the main engines must divert more energy to  
25 the generators so as to enable the associated motors to  
rotate the compressors of the environmental control system  
at a greater speed. Main engine efficiency is thus reduced.

The present invention seeks to provide an improved  
environmental control system for use at least in passenger  
30 carrying aircraft.

According to the present invention an environmental  
control system comprises rotary air compression means,  
first and further rotary air expansion means and common  
rotary electrical drive means connected to drive them via a

single shaft, wherein said air compression means and said first rotary air expansion means are connectable in flow series to an enclosed space volume for the purpose of pressurising it, and said further rotary air expansion means is connectable to said enclosed space volume for the purpose of receiving said pressurised air therefrom, so as to be rotatably driven thereby in order to provide at least some of the power needed to rotate said common electrical drive means via said single shaft.

10       The invention will now be described, by way of example and with reference to the accompanying drawings in which:

Fig.1 is a diagrammatic sketch of an environmental control system in accordance with one aspect of the present invention, and

Fig.2 is a diagrammatic part sketch of a further embodiment of an alternative environmental control system in accordance with the present invention.

The gas generator 10 of a ducted fan gas turbine engine 12 includes an electrical generator (not shown) which in turn is connected by a cable 14 to an electric motor 16 for the purpose of driving it during flight of an associated aircraft, only a cross sectional view of the cabin 18 of which is shown.

25       A single shaft 20 connects motor 16 to a compressor 22, a first expansion turbine 24, and a further expansion turbine 26. During operation of ducted fan gas turbine engine 12, electric motor 16 rotates shaft 20 and causes compressor 22 to receive and compress ambient air. The pressure to which the air is raised, is that needed to achieve appropriate pressurising of the aircraft cabin 18, having regard to the altitude at which the aircraft is flying. The air, heated during compression, passes via conduit 28 which enters and leaves a cooling, ram air flow

tube 30, and then divides to provide a further conduit 28a, which extends to a temperature control valve 32. Conduit 28 however, again enters and leaves ram air tube 30, to pass to and through a heat exchanger 34 associated with a condenser 36 and water separator apparatus 38. On leaving heat exchanger 34, conduit 28 connects the compressed air flow to the input side of turbine 24. Expansion of the air as it passes through turbine 24 reduces its temperature, and on exit therefrom, it joins cooled air that has passed through temperature control valve 32, to flow therewith into condenser 36. Any water in the joined flow is separated and passed via conduit 40 to ram air duct 30, at a position upstream of conduit 28, so as to enable spraying of conduit 28 to achieve further cooling of the air flowing through it.

The now conditioned joined air, on leaving the condensing apparatus, passes via conduit 42, to a manifold 44 in the aircraft cabin 18, from whence it flows into the cabin interior in known, controlled manner. At this point, it is the norm to simply dump the used air overboard through valves in the cabin structure. However, in the structure described and illustrated in this specification, a valve 46 is provided between the cabin 18, and the further turbine 26, which valve has two selectable outlets 48 and 50. Outlet 48 enables dumping of the used air overboard in known manner. Outlet 50 enables direction of the used air into and through further turbine 26 so as to rotate it, and thereby contribute drive power to motor 16, thus reducing the working load on the core gas generator 10. In the latter case, the used air can be dumped via conduit 52 after exiting the further turbine 26. Alternatively, the used air can be re-introduced into the control system at some point of suitable pressure (not shown) and re-conditioned.

The used air will be caused to flow through turbine 26 so as to impart drive to electric motor 16, when the associated aircraft is flying at cruise altitude, which, as is known, is that period in the aircraft flight regime when maximum cabin pressurisation is needed. Thus, as the aircraft climbs to that altitude, valve 46 will be progressively manipulated by any appropriate means (not shown) so as to stop dumping air and start directing it to turbine 26. Maximum pressurising thus coincides with maximum boost drive to motor 16. When the aircraft loses altitude on approaching its destination, the procedure is reversed.

Valve 46 is only diagrammatically represented. It could be electrically actuated, or pneumatically actuated by the changing air pressure in the pressurisation system.

It is vital that the conditioned air has been reduced to an acceptable temperature when it reaches the interior of cabin 18. The heat is generated in the air flow through the system at its input end when ambient air is compressed by compressor 22, hence the need for heat exchanger apparatus. The greater the number of stages of blades in the compressor 22, the larger the heat exchange apparatus must be to achieve the necessary cooling. Therefor an alternative embodiment of the present invention is illustrated in Fig.2, to which reference is now made.

In Fig.2 in which parts corresponding to parts in Fig.1 are given like numbers, the system utilises two compressors 54 and 56 on shaft 20. Each compressor 54 and 56 has fewer stages of blades than compressor 22 (Fig.1). Compressor 54 receives ambient air and compresses it, then emits it at a lower temperature and pressure than that achieved by compressor 22 (Fig.1). The emitted air is ducted via line 28 into and out of ram air tube 30. The now cooled air then divides, one part entering second

compressor 56 and the other part passing via line 28a to temperature control valve 32. The output from compressor 56, again at a lower temperature and pressure than air leaving compressor 22 (Fig.1)1 via ram air tube 30 and heat exchanger 34, passes to expansion turbine 24, the resulting expansion cooling it further. Thereafter, it meets air from temperature control valve 32 and the resulting mixed flow passes to the cabin 18 via the water separator 36 as described hereinbefore, with respect to Fig.1.

10       The example of the present invention described with respect to Fig.1 provides power from pressurised air that hitherto would be dumped to atmosphere, to supplement the power supplied to the electric drive motor normally driven only by an associated aircraft main engine.

15       The example of the present invention described with respect to Fig.2 provides lower temperature air from a pair of compressors prior to the cooling step, thus enabling a reduction in size and weight of the cooling system.

5. An environmental control system as claimed in claim 4 wherein said other compressor further compresses said ambient air from said one compressor and, via said cooling means, delivers it to said first air expansion means which  
5 then delivers the expanded, and thereby further cooled air, to an output conduit from and downstream of said temperature control valve, to mix with said air from said one compressor.
6. An environmental control system as claimed in any of  
10 claims 1 to 6 wherein all said air expansion means are turbine structures.
7. An environmental control system as claimed in any of claims 3 to 6 wherein said mixed air in said outlet conduit from said temperature control valve passes via water  
15 separation apparatus into said enclosed space volume, and is then ejected to atmosphere or to said further expansion means.
8. An environmental control system substantially as described in this specification and with reference to Fig.1  
20 of the accompanying drawings.
9. An environmental control system substantially as described in this specification and with reference to Fig.2 of the accompanying drawings.
10. An environmental control system as claimed in any of  
25 claims 1 to 9 in this specification.
11. An environmental control system as claimed in claim 10 wherein the enclosed space volume comprises the cabin of an aircraft.

ABSTRACT

An environmental control system for e.g. an aircraft cabin comprises ambient air pressurising compressor (16), air cooling device (30), an Air expanding turbine (26), all mounted for rotation on a common shaft (20). A main engine driven electric motor (16) provides the rotary power. An extra expansion turbine (26) is provided on shaft (20) and is connected to receive ejected, used air from cabin (18) and be driven thereby. The rotary force derived from turbine (26) is transferred via shaft (20) to the electric motor (16), thus reducing the power which otherwise would be needed from the aircraft main power plant.

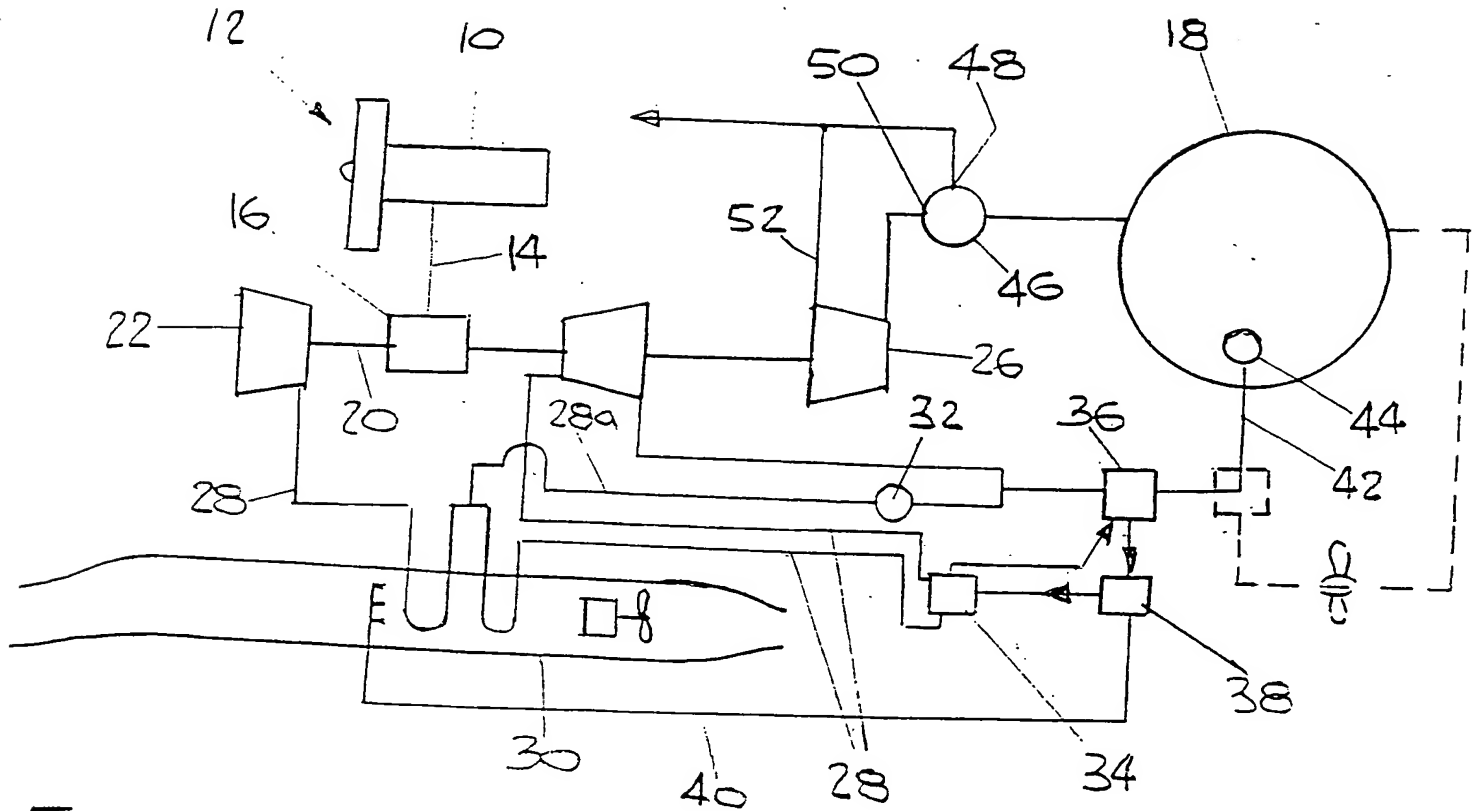


FIG. 1.

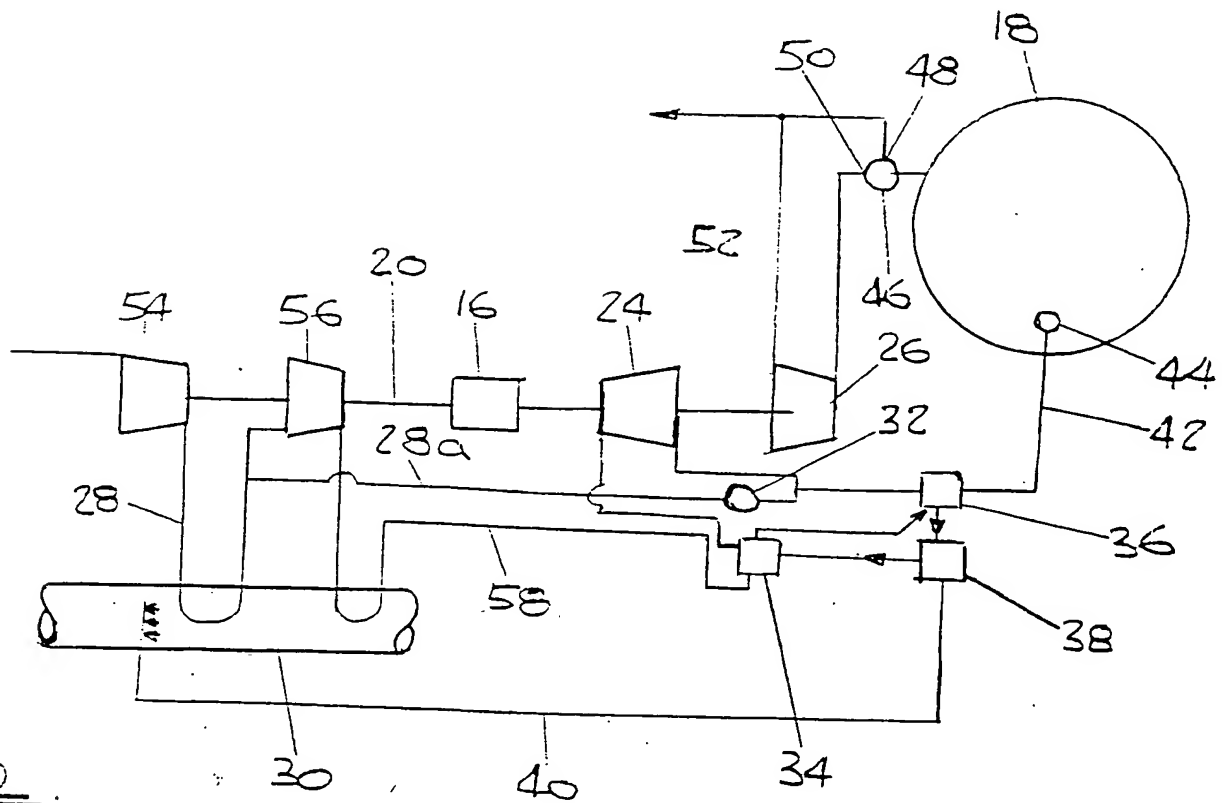


FIG. 2.